Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

Circular No. 574

December 1940 • Washington, D. C.

UNITED STATES DEPARTMENT OF AGRICULTURE

Studies on the "Raisining" of Alexandria (Muscat) Grapes in Transit

By C. E. Asbury, formerly *junior pomologist*, C. O. Bratley, *associate pathologist*, and W. R. Barger, *associate physiologist, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry*

CONTENTS

	Page
Introduction	1
Presentation of results	2
1934 tests	2
1935 tests	3
1936 tests	5
Presentation of results—Continued.	
1937 tests	7
Discussion of results of test shipments	9
Summary	10

INTRODUCTION

There has perhaps been more controversy over changes in color and firmness of Alexandria (Muscat of Alexandria, known in the trade as "Muscat") grapes during transit than over similar changes in any other variety. In normal seasons grapes of this variety will attain a sugar content satisfactory for shipping before the eastern juice-grape market is ready to absorb any considerable volume. This forces growers either to pick the fruit for drying into commercial raisins or to allow it to remain on the vine until the market is receptive, knowing that some of the bunches will show various stages of drying when they are shipped. Buyers and receivers often complain of excess amounts of "raisined" or "raisining" berries when the fruit is delivered at the eastern market, contending that the number of grapes so affected increased during the transit period. Raisined grapes, according to the terminology used by the Farm Products Inspection Service of the Agricultural Marketing Service, resemble commercial raisins, and are so dry that no juice can be obtained from them when they are squeezed between the thumb and forefinger. Alexandria grapes showing raisining are characterized by the development of a brownish color, high sugar content, and a wrinkled appearance, but still contain enough juice so that some can be squeezed from them. The alteration in appearance and physical characteristics which grapes of this variety undergo during the

transit period was investigated during the seasons of 1934 to 1937, inclusive, to answer specifically the question whether or not the percentage of grapes classified as showing raisining could be expected to increase while in transit.

PRESENTATION OF RESULTS

1934 Tests

A preliminary storage test was made in the early fall of 1934 with Alexandria grapes in which the fruit was held for a 10-day period at 50° F. and a relative humidity of 65 to 75 percent, to approximate conditions of shipment from the San Joaquin Valley of California to eastern markets. Before being stored the grapes were divided into four classes according to their color and degree of curing as follows:

Class 1.—Majority of berries yellow and shriveled.
Class 2.—About one-fourth of berries yellow and shriveled.
Class 3.—Some of the berries yellow, but none shriveled.
Class 4.—All berries green.

Under these storage conditions, which were probably slightly higher in temperature and drier than would be normally met with in transit, considerable moisture loss was experienced during the 10-day period. Classes 1 and 2, the most advanced in maturity, surprisingly enough lost more moisture than did classes 3 and 4, the loss in the former classes amounting to about 4 percent as compared to 3.4 and 3.6 percent, respectively, in classes 3 and 4. There was only a very slight change in the general condition of the fruit. The stems had dried slightly and the berries had become somewhat softer, but they were essentially in the same condition as at the beginning of the storage period. Upon being subjected for 10 days to room temperatures, considerable changes took place in the appearance and condition of the grapes, but the brown color indicative of raisining did not develop in either class 3 or 4, although the grapes became wrinkled and pitted. The sides of berries in classes 1 and 2, which were brown when stored, became sunken and took on a grayish cast, with wrinkles appearing in other portions of the berry. From the results of this storage test it would be expected that little raisining would develop in transit except in fruit already in the initial stages of raisining.

Following the preliminary storage test, an experimental shipment of Alexandria grapes was made in October 1934. Grapes for this test were picked from a typical vineyard and separated into the following classes:

Class 1.—Ripe; some berries on each bunch had started to shrivel and discolor, but all showing raisining were clipped from the bunches.
Class 2.—Yellow; berries mostly yellow but not shriveled.
Class 3.—Green; all of the fruit green in color.

Enough grapes were obtained to pack one lug of each of these classes. Shipment was made to the New York market in a commercial carload of grapes, precooled, with the bunkers initially iced, replenished and re-iced once in transit. The car arrived at destination on the tenth morning after loading and was held over until the thirteenth morning when it was opened and the test lugs were removed and inspected. A recording thermometer packed in a lug of grapes loaded in the top layer of the doorway stack of the test car showed an

initial temperature of 54° F. at the time of shipment, and at the end of 2-day intervals thereafter the temperatures recorded were, respectively, 48°, 43°, 42°, 38°, and 36°. After removal from the refrigerator car, the test lugs of grapes were held for 7 days at a temperature of about 70° with a relative humidity of about 50 percent. The loss in weight in the grapes during the transit and market holding period and the amount of raisining observed in the various lots are given in table 1.

TABLE 1.—*Loss of weight and increase in raisining in Alexandria grapes of various maturities during a 13-day transit period and a subsequent holding period of 7 days after arrival, October 10–30, 1934*

Classification when shipped		Weight loss in transit	Grapes showing raisining on arrival [1]	Weight loss during 7-day holding period after unloaded [2]	Total weight loss during transit and holding period	Grapes showing raisining at end of 7-day holding period
Class No.	Description					
		Percent	*Percent*	*Percent*	*Percent*	*Percent*
1	Ripe	1.99	12.00	4.78	6.77	23.00
2	Yellow	2.64	.03	2.84	5.48	3.00
3	Green	2.64	0	.81	3.45	.02

[1] Berries showing raisining were discolored, shriveled, and had lost at least 3/16 of their original turgid volume.

[2] During the 7-day holding period after arrival the fruit was exposed to temperatures of about 70° F. and humidities of about 50 percent.

From this test it would appear that Alexandria grapes that have begun to shrivel and show raisining when picked, such as those shipped in class 1, are subject to further raisining during the transit and marketing period. Less mature grapes, yellow but not shriveled when picked (class 2), developed no appreciable amount of raisining in transit, but some raisining had developed at the end of the 7-day holding period. Considerable loss in weight accompanied raisining, and as the respiration rate of grapes is low, accounting for only small losses of solid material, it can be assumed that most of the loss in weight was due to transpiration of water from the grapes. Fruit that was green when shipped developed practically no raisining during the 13-day transit period and the 7-day holding period.

1935 Tests

A different method of segregating grapes of various stages of maturity was adopted for the studies of raisining in transit in 1935 from that employed in the previous season. It was thought that the clipping of berries from a bunch so that those remaining would conform to a single predetermined classification might cause the latter to behave in an abnormal manner because of excessive loss of moisture from the cut stems. Consequently, only damaged berries were removed from the bunches shipped in 1935. The individual grapes were classified according to their stage of maturity and the bunch was tagged with appropriate data and placed in the lug for shipment to New York.

A classification describing the stages of maturity frequently found in commercial lots of Alexandria grapes was set up and used at both the shipping and receiving points. The descriptions used in recording the six degrees of raisining existing at the time of examination are given in table 2.

TABLE 2.—*Changes in the color and firmness of Alexandria grapes during a 14-day transit period in 1935*

Classification when shipped		Distribution of grapes into respective classes when shipped		Distribution of grapes into respective classes upon arrival		Changes in class distribution during transit period	
Class No.	Description						
	TEST SHIPMENT NO. 1, NOV. 1–15						
		Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*
1	Grapes showing no browning, not flabby nor wrinkled, but plump	1,338	82.2	1,161	71.4	−177	−10.9
2	Grapes showing browning, characteristic of initial raisining over at least ½ of berry, otherwise the same as classification No. 1	9	.6	111	6.8	+102	+6.3
3	Grapes slightly flabby, showing not less than ⅔ of original volume	174	10.7	219	13.4	+45	+2.7
4	Grapes severely wrinkled, but retaining between ½ and ⅔ of original volume	80	4.9	95	5.8	+15	+.9
5	Grapes angular in outline with less than ½ of original volume, but moist enough to exude liquid when squeezed	26	1.6	40	2.5	+14	+.9
6	Grapes angular in outline, typical of commercial raisin	0	0	1	.1	+1	+.1
	TEST SHIPMENT NO. 2, NOV. 5–19						
1	Grapes showing no browning, not flabby nor wrinkled but plump	3,079	80.2	2,777	72.3	−302	−7.9
2	Grapes showing browning, characteristic of initial raisining over at least ½ of berry, otherwise the same as classification No. 1	49	1.3	150	3.9	+101	+2.6
3	Grapes slightly flabby, showing not less than ⅔ of original volume	312	8.1	438	11.4	+126	+3.3
4	Grapes severely wrinkled, but retaining between ½ and ⅔ of original volume	159	4.1	177	4.6	+18	+.5
5	Grapes angular in outline with less than ½ of original volume, but moist enough to exude liquid when squeezed	157	4.1	177	4.6	+20	+.5
6	Grapes angular in outline, typical of commercial raisin	85	2.2	122	3.2	+37	+1.0

The shipping season was almost a month behind that of 1934, the vines blossoming late, and the fruit maturing correspondingly later than in the previous season. Picking of all varieties was delayed, and late grapes in some districts never reached a satisfactory stage of maturity. This situation was complicated by early rains, which favored the growth of spoilage organisms on the unharvested fruit. The grapes in the vineyard from which the 1935 samples were taken were so moldy by the time the studies could be started they could not be used. Almost every berry that showed even slight raisining was attacked by gray mold rot. The first stages of gray mold infection resembled the browning characteristic of incipient raisining and might be mistaken for it, but it was found that slight pressure would split the weakened skin of infected berries. These affected berries and all berries that were cracked or loose at the cap stem were clipped from the bunches.

Light frosts occurred during the week of October 22, causing foliage injury, but little stem or berry damage. The heavy freeze that

occurred on October 31 did serious damage to most vineyards, but for some unknown reason did not freeze many Alexandria crops, although the leaves were killed and exposed stems were severely injured. Sufficient unfrosted fruit was harvested on November 1 from a vineyard in the Clotho district to furnish the grapes used in the two test shipments made. Later, frosts damaged the crop to such an extent that additional pickings were inadvisable.

Part of the grapes were classified and shipped to New York with a carload of table grapes on the same day they were harvested, November 1. Because of market conditions the car was not offered for sale until November 15, 14 days later. The next test was also in the refrigerator car 14 days before being unloaded. Both cars were precooled with portable fans, fumigated by burning 5 pounds of sulfur in the loaded car, and shipped under rule 254 [1] with one re-icing in transit.

When the lug arrived in New York each bunch was taken out and the berries were removed and segregated into the classifications shown in table 2. Differences between the number in each class marked on the tag in California and that recorded in New York were noted, these differences representing the berries that had changed noticeably in color and firmness during the transit period. The results obtained in the first test, comprising 45 bunches, and in the second test shipment, consisting of 97 bunches, are presented in table 2.

It is apparent from table 2 that a sufficient number of berries changed in color and firmness to give some basis for the widespread belief that the Alexandria variety is susceptible to raisining in transit. The firm, plump, green or yellow berries making up classification No. 1 in both shipments were fewer by about 11 and 8 percent, respectively, upon arrival than when shipped, and all other classifications contained greater numbers than when shipped. Classes 2 and 3, that is, the first stages of raisining, showed most of the increase. However, the changes in this small percentage of fruit were not great, consisting mostly of slight alterations in color or firmness. This, if typical of the behavior of commercial carlots of Alexandria grapes, indicates that serious raisining should not develop during the usual transit period of 10 days to 2 weeks in grapes that are free from the early stages of raisining when they are shipped.

1936 Tests

The methods followed in the 1936 test were similar to those outlined for the 1935 season. However, a slightly different classification of the test fruit was used, to permit a closer segregation of the grapes. In 1936 the first classification of the 1935 season was divided into two parts according to color, the turgid green fruit making up one classification and the turgid yellow fruit another. Class 3 was added to those of 1935 to permit segregation in a separate class of fruit that was shriveled but not discolored. Class 4, consisting of brown grapes not shriveled and therefore not showing raisining, corresponded exactly to the second classification of 1935, whereas class 5 was a new classification to cover those berries which showed only slight shriveling accompanied by browning. New classes 6, 7, and 8 corresponded to the 1935 classes 3, 4, and 5, respectively. Since raisining, as defined

[1] National Perishable Freight Committee. Perishable Protective Tariff 10, Sup. 18. 1939. Issued by J. J. Quinn, agent, 516 West Jackson Blvd., Chicago, Ill.

above, involved a combination of browning and shriveling, classes 1 to 4 were free from raisining and 5 to 8 showed various stages of it. These classification groups were used in both the 1936 and 1937 tests.

A better understanding of these classifications was established between the workers by their going over a considerable number of bunches of Alexandria grapes together and agreeing on the classification of the individual berries. It was also discovered that marking the individual berries and photographing the bunches was very helpful in noting physical changes (fig. 1). Accordingly, in classifying the

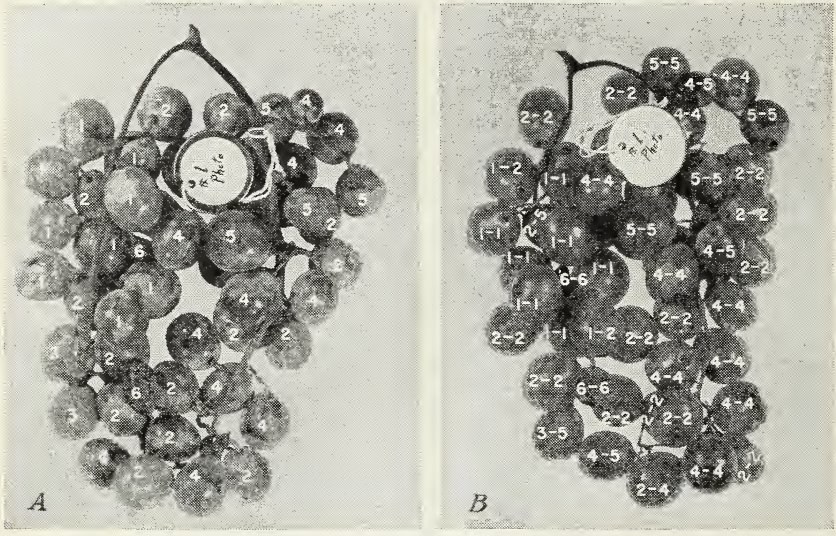

FIGURE 1.—A bunch of Alexandria grapes shipped in 1937 with berries marked to indicate the class to which they belong. *A*, At time of packing; *B*, on arrival at New York City.

fruit at the shipping point all berries were marked with the appropriate group number. Upon arrival in New York the grapes were clipped from the bunches and segregated into their respective groups. The first test shipment was made on November 3 and the second November 5, each in a car that was precooled and fumigated by burning 5 pounds of sulfur within the car; further, to control mold on the fruit in transit, 5 gm. of sodium bisulfite was added to the top and bottom pads of the test lugs. The cars were unloaded when they arrived in New York 10 and 11 days, respectively, after shipment, and the test lugs were removed and inspected. The changes that took place during the transit period are summarized in table 3.

It is evident that yellow or amber-colored fruit showing no shriveling or brown color when packed (class 2) was most subject to change during the transit period. The changes taking place during shipment involved color chiefly rather than shriveling, as demonstrated by the fact that the percentage of fruit in class 4 (grapes, brown, not shriveled) gained more than any other group during the 10-day transit period. Because grapes showing raisining are both shriveled and brown, the increase in class 4 was not an increase in raisining but only a change in

color. The increases in classes 5 and 6, totaling 2.6 and 3.3 percent, respectively, in the two tests, can be considered as an increase in raisining, for grapes in these groups were shriveled and brown, characteristic of raisining. It is probable that grapes that were slightly shriveled or browned, such as those of classes 3 and 4, contributed most to the increase in raisining during the transit period. There was no increase in the number of grapes showing advanced stages of raisining, classes 7 and 8.

TABLE 3.—*Changes in the color and firmness of Alexandria grapes during transit periods of 10 and 11 days, 1936*

TEST SHIPMENT NO. 1, NOV. 3–13

Classification when shipped		Distribution of grapes into respective classes when shipped		Distribution of grapes into respective classes upon arrival		Changes in class distribution during transit period	
Class No.	Description	*Number*	*Percent*	*Number*[1]	*Percent*	*Number*	*Percent*
1	Grapes green, turgid	1	0.1	0	0	−1	−0.1
2	Grapes yellow or amber, turgid	942	84.8	742	66.9	−200	−17.9
3	Grapes yellow or amber, slightly shriveled	24	2.2	11	1.0	−13	−1.2
4	Grapes brown, not shriveled	56	5.0	239	21.6	+183	+16.6
5	Grapes brown, slightly shriveled	41	3.7	47	4.2	+6	+.5
6	Grapes brown, shriveled but retaining ⅔ or more of original volume	41	3.7	64	5.8	+23	+2.1
7	Same as No. 6, but grapes containing less than ⅔ of original volume	4	.4	4	.4	0	0
8	Angular, dark brown, with less than ½ of original volume	2	.2	2	.2	0	0
	TEST SHIPMENT NO. 2, NOV. 5–19						
1	Grapes green, turgid	0	0	0	0	0	0
2	Grapes yellow or amber, turgid	1,580	90.0	1,389	79.1	−191	−10.8
3	Grapes yellow or amber, slightly shriveled	62	3.5	34	1.9	−28	−1.6
4	Grapes brown, not shriveled	60	3.4	220	12.5	+160	+9.1
5	Grapes brown, slightly shriveled	37	2.1	71	4.1	+34	+1.9
6	Grapes brown, shriveled but retaining ⅔ or more of original volume	17	1.0	42	2.4	+25	+1.4
7	Same as No. 6, but grapes containing less than ⅔ of original volume	0	0	0	0	0	0
8	Angular, dark brown, with less than ½ of original volume	0	0	0	0	0	0

[1] 2 grapes were lost from test shipment No. 1 during transit.

1937 TESTS

The first shipment made in 1937 was on October 9, using the same methods of classification as were used in the 1936 tests (see p. 5). Shipment was made in a precooled fumigated car as in previous tests, the test lot being unloaded and inspected in New York 11 days after loading. The second shipment was made on October 11 and required 10 days for delivery to market. A third and final shipment was made November 6, 12 days elapsing between the time of initial classification and the inspection in New York City. The results obtained in these tests are presented in tables 4 and 5.

The increase in the number of berries showing raisining, as evidenced by both brown color and shriveling (classes 5, 6, 7, and 8)

amounted to 10.3 percent of shipment No. 1, 6.2 percent of shipment No. 2, and 8.0 percent of shipment No. 3. Although it is true that the class losing the greatest number was in all cases No. 1, or the least mature fruit shipped, the evidence presented in table 5 indicates clearly that very few grapes showing actual raisining developed from this class. Classes 3 and 4 contributed the greatest number of berries to those showing raisining on arrival.

TABLE 4.—*Changes in the color and firmness of Alexandria grapes during transit periods of 11, 10, and 12 days, 1937*

Classification when shipped		Distribution of grapes into respective classes when shipped		Distribution of grapes into respective classes upon arrival		Changes in class distribution during transit period	
Class No.	Description	*Number*	*Percent*	*Number*[1]	*Percent*	*Number*	*Percent*
	TEST SHIPMENT NO. 1, OCT. 9–20						
1	Grapes green, turgid	386	29.4	272	20.7	−114	−8.7
2	Grapes yellow or amber, turgid	426	32.4	392	29.9	−34	−2.5
3	Grapes yellow or amber, slightly shriveled	82	6.2	50	3.8	−32	−2.4
4	Grapes brown, not shriveled	161	12.2	204	15.5	+43	+3.3
5	Grapes brown, slightly shriveled	111	8.4	190	14.5	+79	+6.1
6	Grapes brown, shriveled but retaining ⅔ or more of original volume	93	7.1	137	10.5	+44	+3.4
7	Same as No. 6, but grapes containing less than ⅔ of original volume	48	3.7	56	4.3	+8	+.6
8	Angular, dark brown, with less than ½ of original volume	8	.6	11	.8	+3	+.2
	TEST SHIPMENT NO. 2, OCT. 11–21						
1	Grapes green, turgid	644	44.4	505	34.8	−139	−9.6
2	Grapes yellow or amber, turgid	371	25.5	433	29.8	+62	+4.3
3	Grapes yellow or amber, slightly shriveled	121	8.3	102	7.0	−19	−1.3
4	Grapes brown, not shriveled	172	11.8	178	12.3	+6	+.4
5	Grapes brown, slightly shriveled	85	5.9	144	9.9	+59	+4.1
6	Grapes brown, shriveled but retaining ⅔ or more of original volume	33	2.3	59	4.1	+26	+1.8
7	Same as No. 6, but grapes containing less than ⅔ of original volume	19	1.3	24	1.6	+5	+.3
8	Angular, dark brown, with less than ½ of original volume	7	.5	7	.5	0	0
	TEST SHIPMENT NO. 3, NOV. 6–18						
1	Grapes green, turgid	338	23.6	263	18.4	−75	−5.2
2	Grapes yellow or amber, turgid	604	42.2	567	39.6	−37	−2.6
3	Grapes yellow or amber, slightly shriveled	193	13.5	123	8.6	−70	−4.9
4	Grapes brown, not shriveled	131	9.2	198	13.8	+67	+4.7
5	Grapes brown, slightly shriveled	134	9.4	219	15.3	+85	+5.9
6	Grapes brown, shriveled but retaining ⅔ or more of original volume	20	1.4	47	3.3	+27	+1.9
7	Same as No. 6, but grapes containing less than ⅔ of original volume	9	.6	11	.8	+2	+.1
8	Angular, dark brown, with less than ½ of original volume	2	.1	3	.2	+1	+.1

[1] 3 grapes were lost from test shipment No. 1 during transit.

TABLE 5.—*Detailed changes occurring in each group of Alexandria grapes during a 12-day transit period, test shipment No. 3, Nov. 6–18, 1937*

Classification when shipped			Reclassification of grapes upon arrival							
Class No.	Description	Number of berries	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Class 8
			Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
1	Grapes green, turgid	338	77.8	17.5	0.6	3.8	0.3	0	0	0
2	Grapes yellow or amber, turgid	604		84.1	2.3	11.6	2.0	0	0	0
3	Grapes yellow or amber, slightly shriveled	193			55.0	0	43.0	2.0	0	0
4	Grapes brown, not shriveled	131				87.8	12.2	0	0	0
5	Grapes brown, slightly shriveled	134					79.9	20.1	0	0
6	Grapes brown, shriveled but retaining ¾ or more of original volume	20						85.0	15.0	0
7	Same as No. 6, but grapes containing less than ¾ of original volume	9							88.9	11.1
8	Angular, dark brown, with less than ½ of original volume	2								100.0

DISCUSSION OF RESULTS OF TEST SHIPMENTS

The increase in percentage of berries showing raisining on the market as compared with the amount present when the grapes were shipped is summarized in table 6.

TABLE 6.—*Summary of increases in raisining in transit encountered in tests made in 1935, 1936, and 1937*

Shipment	Condition when shipped		Increase in percentage of berries showing raisining, classes 5, 6, 7, and 8, during transit
	Berries brown but not shriveled (class No. 4)	Berries shriveled but not brown (class No. 3)	
	Percent	*Percent*	*Percent*
1935, No. 1			7.2
1935, No. 2			3.1
1936, No. 1	5.0	2.2	2.6
1936, No. 2	3.4	3.5	3.3
1937, No. 1	12.2	6.2	10.3
1937, No. 2	11.8	8.3	6.2
1937, No. 3	9.2	13.5	8.0

It is evident that some increase in raisining can be expected during the normal transit period, but that the condition of the grapes when they are shipped to a large extent will govern the amount of raisining developing in transit. For example, in the tests of 1937, a considerable number of berries were either shriveled or brown in color by the time they were picked, although they did not show a combination of

browning and shriveling so that they could be considered to have reached the condition of raisining. In these shipments there was rather a marked increase in the percentage of raisining berries during the transit period, ranging from 6.2 percent in test No. 2 to 10.3 percent in test No. 1. In contrast, in 1936 a much smaller number of berries were shriveled or brown when shipped and because of this the increase in raisining amounted to only 2.6 and 3.3 percent in the first and second shipments, respectively. These results are in essential agreement with those of Rose,[2] who conducted shipping tests with Alexandria grapes and compared inspection certificates of cars of grapes issued at shipping point with those issued at terminal market. Rose concluded that lots of grapes that show many wilted berries and considerable raisining at time of shipment are likely to show much greater raisining in transit than grapes relatively free from this condition when shipped.

SUMMARY

Raisining in Alexandria (Muscat of Alexandria, known in the trade as "Muscat") grapes, a condition involving both shriveling and the development of a brown color, was found to proceed to some extent during a 10- to 14-day transit period in test shipments made from California to New York City. The increase in the percentage of grapes showing raisining ranged from 2.6 to 10.3 percent. Grapes that were shriveled or brown in color when shipped contributed the most to the increase of raisining in transit. Grapes that were green, yellow, or amber in color and not shriveled when shipped showed practically no raisining on arrival, but the amber-colored grapes often became slightly brown during the transit period.

[2] Rose, Dean H. Unpublished data on studies made in 1925 and 1926. U. S. Department of Agriculture.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE WHEN THIS PUBLICATION WAS LAST PRINTED

Secretary of Agriculture	CLAUDE R. WICKARD.
Under Secretary	PAUL H. APPLEBY.
Assistant Secretary	GROVER B. HILL.
Director of Information	M. S. EISENHOWER.
Director of Extension Work	M. L. WILSON.
Director of Finance	W. A. JUMP.
Director of Personnel	ROY F. HENDRICKSON.
Director of Research	JAMES T. JARDINE.
Director of Marketing	MILO R. PERKINS.
Solicitor	MASTIN G. WHITE.
Land Use Coordinator	M. S. EISENHOWER.
Office of Plant and Operations	ARTHUR B. THATCHER, *Chief.*
Office of Civilian Conservation Corps Activities	FRED W. MORRELL, *Chief.*
Office of Experiment Stations	JAMES T. JARDINE, *Chief.*
Office of Foreign Agricultural Relations	LESLIE A. WHEELER, *Director.*
Agricultural Adjustment Administration	R. M. EVANS, *Administrator.*
Bureau of Agricultural Chemistry and Engineering.	HENRY G. KNIGHT, *Chief.*
Bureau of Agricultural Economics	H. R. TOLLEY, *Chief.*
Agricultural Marketing Service	C. W. KITCHEN, *Chief.*
Bureau of Animal Industry	JOHN R. MOHLER, *Chief.*
Commodity Credit Corporation	CARL B. ROBBINS, *President.*
Commodity Exchange Administration	JOSEPH M. MEHL, *Chief.*
Bureau of Dairy Industry	O. E. REED, *Chief.*
Bureau of Entomology and Plant Quarantine	LEE A. STRONG, *Chief.*
Farm Credit Administration	A. G. BLACK, *Governor.*
Farm Security Administration	C. B. BALDWIN, *Administrator.*
Federal Crop Insurance Corporation	LEROY K. SMITH, *Manager.*
Forest Service	EARLE H. CLAPP, *Acting Chief.*
Bureau of Home Economics	LOUISE STANLEY, *Chief.*
Library	CLARIBEL R. BARNETT, *Librarian.*
Bureau of Plant Industry	E. C. AUCHTER, *Chief.*
Rural Electrification Administration	HARRY SLATTERY, *Administrator.*
Soil Conservation Service	H. H. BENNETT, *Chief.*
Surplus Marketing Administration	MILO R. PERKINS, *Administrator.*

This circular is a contribution from

Bureau of Plant Industry	E. C. AUCHTER, *Chief.*
Division of Fruit and Vegetable Crops and Diseases.	H. P. GOULD, *Principal Horticulturist, in Charge.*

U. S. GOVERNMENT PRINTING OFFICE: 1940

For sale by the Superintendent of Documents, Washington, D. C. - - - - - - Price 5 cents